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(71) Applicant (for all designated States except US): SAMSUNG CLIMATE CONTROL CO., LTD. [KR/KR]; 456-4 Nae-dong, Changwon-si, 641-050 Kyungsangnam-do (KR).

(72) Inventors; and
(75) Inventors/Applicants (for US only): KIM, YoungJin [KR/KR]; 102-1605 Haniltown, Yangduk2-dong, Masan-si, 630-492 Kyungsangnam-do (KR). SONG, YiSeok [KR/KR]; 408 Dongsungsaepyultown, 456-20, Nae-dong, Changwon-si, 641-050 Kyungsangnam-do (KR).

(74) Agent: YOON, EuiSeoup; Yoones & Co., Namdo Building, 3rd Floor, 823-24, Yoksam-dong, Kangnam-ku, Seoul 135-080 (KR).

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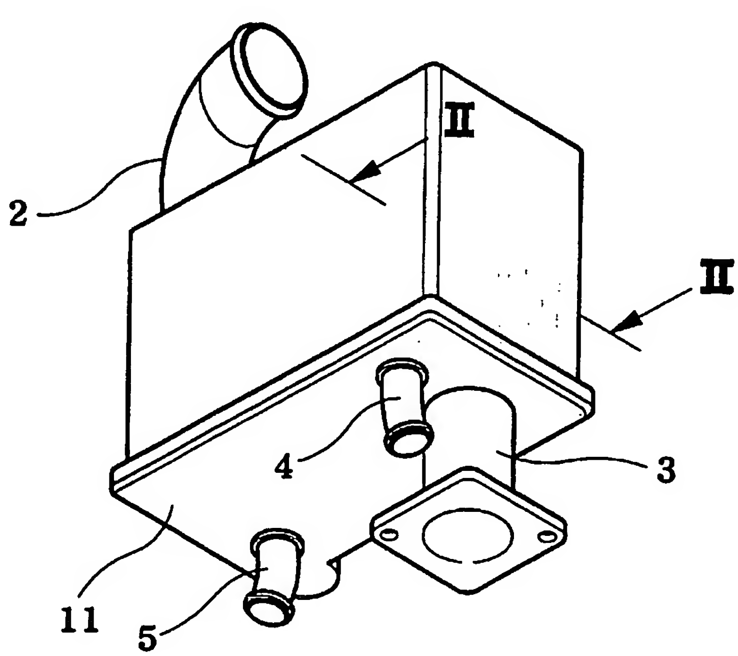
(54) Title: WATER COOLING HEAT EXCHANGER



(57) Abstract: The water cooling heat exchanger according to the present invention is implemented in such a manner that an odd number plate and an even number plate are alternately stacked and bonded. The above odd number plate includes a bonding portion formed along an edge portion of the same, a first inlet tank portion and a first discharging tank portion formed in the boding portion at a certain distance from each other, and a second inlet tank hole and a second discharging tank distanced from each other and protruded, and the above even number plate includes a bonding portion formed along an edge portion and a first inlet and discharging tank hole corresponding to each tank portion of the odd number plate in the bonding portion and a protruded second inlet and discharging tank portion corresponding to each tank hole of the odd number plate.

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WATER COOLING HEAT EXCHANGER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a water cooling heat exchanger which cools or heat a cooled fluid based on a heat exchange between a cooling water and a cooled fluid, and in particular to a water cooling heat exchanger which is capable of alternately forming a cooling water flow path and a cooled fluid flow path based on a plate stacked structure and providing a head radiating area in each flow path based in an interposed heat radiating fan.

2. Description of the Background Art

Generally, various heat exchangers for cooling various cooled fluids such as a cooling water or coolant used in a radiator for cooling an engine cooling water or a condenser for cooling a refrigerant of an air conditioner. The heat exchanger is classified into an air cooling type and a water cooling type based on a cooling fluid for cooling the cooled fluid. Here, the air cooling type uses an external air as a cooling fluid, and the water cooling type uses a water as a cooling fluid.

A charge air cooler generally uses an air cooling type heat exchanger capable of cooling an air having an increased pressure and charged by a turbo charger, increasing a density of the air having a lower density due to an increase of a temperature due to an increased pressure and increasing a fuel combustion efficiency of an engine and the power of the engine. The oil cooler cools an oil which lubricates a power transfer system of a vehicle, decreases a decrease of a density of an oil due to a temperature increase and prevents a mechanism friction and abrasion due to an oil density decrease for thereby based on a selective use of the air cooling type or the water cooling type.

The conventional air cooling type heat exchanger which is used for the

charge air cooler or oil cooler uses air which has a low heat transfer efficiency as a cooling fluid. In addition, since a heat radiating fin which is used for increasing a heat radiating area of two fluids is selectively used between a flow path of a cooled fluid and a flow path of a cooling fluid for enhancing a heat exchange efficiency between a cooled fluid(for example, a charged air or oil) and a cooling fluid)(for example, a cooling water or external air), the heat exchange efficiency is low. In addition, in the case of the conventional water cooling type heat exchanger, the above two fluids are flown through the flow paths formed inside and outside the pipe installed in a housing for enhancing a heat transfer efficiency between the cooling fluid(for example, a cooling water) and a cooled fluid(for example, oil), so that it is possible to enhance a heat transfer efficiency between the above two fluids. In this case, since a heat radiating fin is installed in one between the above two flow paths, the heat exchange efficiency is low. The volume is increased due to the housing. Therefore, it is not well adaptable to a vehicle. The number of parts is increased, so that an assembling procedure is complicated.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a water cooling heating exchanger which may be used for a charge air cooler which cools an over charged air from a combustion chamber of an engine or an oil cooler capable of cooling an oil used for lubricating a power transfer system and implements a plate stacked structure without a housing for hereby increasing a heat exchange efficiency compared to a volume, improving an assembling procedure and decreasing a fabrication cost.

To achieve the above objects, there is provided a water cooling heat exchanger which includes a plate stacked structure in which an odd number plate and an even number plate are alternately stacked and bonded, said odd number plate having a bonding portion formed along an edge portion of the

same, a first inlet tank portion and a first discharging tank portion formed in the boding portion at a certain distance from each other, and a second inlet tank hole and a second discharging tank distanced from each other and protruded; and said even number plate having a bonding portion formed along an edge portion in a certain shape capable of corresponding with the odd number plate and a first inlet and discharging tank hole corresponding to the first inlet and discharging tank portion of the odd number plate in the bonding portion and a protruded second Inlet and discharging tank portion corresponding to the second inlet and discharging tank hole of the odd number plate, whereby different fluids are flown through the first inlet tank formed by the first inlet tank portion and the second inlet tank formed by the second inlet tank portions, and each fluid is flown through each flow path separated by each plate and is discharged through the first discharging tank formed by the first discharging tank portions and the second discharging tank formed by the second discharging tank portions.

In the present invention, there is further provided a heat radiating fin interposed between the plates for thereby expanding a heat transfer area of each fluid flowing through the flow paths between the plates.

The first inlet tank and second inlet tank and the first discharging tank and second discharging tank are installed opposite to each other, respectively, so that the flowing directions of two fluids are crossed.

In the present invention, there is further provided upper and lower supports bonded to the upper and lower potions of the plate stacked structure for thereby enhancing a bonding strength of the stacked structure.

In the present invention, there is further provided a first inlet and discharging pipe bonded to opposite sides with respect to the plate stacked structure and connected with the first inlet tank and the first discharging tank, and a second inlet and discharging pipe bonded in the same direction with respect to the plate stacked structure and connected with the second inlet tank and the second discharging tank.

The plates are formed of a circular flat plate, and the stacked structure is cylindrical.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become better understood with reference to the accompanying drawings which are given only by way of illustration and thus are not limitative of the present invention, wherein;

Figure 1 is a perspective view illustrating a water cooling heat exchanger according to an embodiment of the present invention;

Figure 2 is a cross sectional view taken along line II-II of Figure 1;

Figure 3 is a plan view illustrating an odd number plate which forms a plate stacked structure in a water cooling heat exchanger according to an embodiment of the present invention;

Figure 4 is a plan view illustrating an odd number plate in which a heat radiating fin is engaged in a water cooling heat exchanger according to an embodiment of the present invention;

Figure 5 is a plan view illustrating an even number plate which forms a plate stacked structure in a water cooling heat exchanger according to an embodiment of the present invention;

Figure 6 is a plan and front view of a heat radiating fin interposed on an even number plate in a water cooling heat exchanger according to an embodiment of the present invention;

Figure 7 is a plan view illustrating an upper plate of a water cooling heat exchanger and a cross-sectional view taken along line A-A of the plan view according to an embodiment of the present invention;

Figure 8 is a front view illustrating a lower support of a water cooling heat exchanger and a bottom view of the same according to the present invention;

Figure 9 is a plan view illustrating an upper support of a water cooling

heat exchanger according to an embodiment of the present invention;

Figure 10 is a perspective view illustrating a water cooling heat exchanger according to another embodiment of the present invention;

Figure 11 is a plan view and front view illustrating a water cooling heat exchanger according to another embodiment of the present invention;

Figure 12 is a cross sectional view taken along line XII-XII of Figure 11;

Figure 13 is a plan view illustrating an odd number plate of a water cooling heat exchanger and a cross sectional view taken along line B-B of the plan view according to another embodiment of the present invention;

Figure 14 is a plan view illustrating an even number plate of a water cooling heat exchanger and a cross sectional view taken along line C-C of the plan view according to another embodiment of the present invention;

Figure 15 is a plan view illustrating a heat radiating fin of a water cooling heat exchanger according to another embodiment of the present invention;

Figure 16 is a plan view illustrating a lower plate of a water cooling heat exchanger according to another embodiment of the present invention;

Figure 17 is a plan view illustrating a lower support of a water cooling heat exchanger according to another embodiment of the present invention; and

Figure 18 is a plan view illustrating an upper support of a water cooling heat exchanger according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The construction, operation and effects of the water cooling heat exchanger according to the present invention will be explained with reference to the accompanying drawings.

Figure 1 is a perspective view illustrating a water cooling heat exchanger according to an embodiment of the present invention, and Figure 2 is a cross sectional view taken along line II-II of Figure 1.

As shown in Figure 1, the water cooling heat exchanger according to the present invention is directed to a heat exchanger in which a charged air supplied to an engine is cooled for enhancing a combustion efficiency of an engine and increasing a density of the same for thereby implementing an operation of a charge air cooler. The charge air cooler is directed to cooling a charged air using a cooling water which is capable of cooling engine based on a circulation between the engine and a radiator.

As shown in Figure 1, the charge air cooler includes a cubic shaped plate stacked structure 1 which implements a heat exchange between two fluids by forming a charged air flow path and a cooling water flow path which are alternately formed in the interior of the same and flowing the charged air and cooling water therethrough each flow path, a second inlet pipe 4 installed at a lower corner portion of the stacked structure 1 for introducing a coolant from a radiator(not shown), a first inlet pipe 2 installed in an upper portion of the stacked structure 1 for introducing a charged air from a turbo charger(not shown), a first discharging pipe 3 installed in the opposite side of the first inlet pipe 2 in a lower portion of the stacked structure 1 for discharging the charged air, and a second discharging pipe 5 installed in the opposite side of the second inlet pipe 4 in a lower portion of the stacked structure 1 for discharging the cooling water.

As shown in Figure 2, in the plate stacked structure 1, two kinds of plates 13 and 14 having corresponding structures are alternately stacked between the upper support 12 and the lower support 11 by interposing the heat radiating fins 15 and 16 therebetween and are bonded by a brazing method. In the interior of the plate stacked structure, a first flow path 14a which flows a charged air flows from the first inlet pipe 2 to the first discharging pipe 3 and is formed in double lines and a second flow path 13a which flows the cooling water from the second inlet pipe 4 to the second discharging pipe 5 and is formed in double lines are alternately formed. The plate stacked structure 1 is capable of heat-exchanging the charged air flowing in the first

flow path 14a with a cooling water flowing in the second flow path 13a.

Figures 3 and 5 are views illustrating the odd number plate 13 and the even number plate 14 of two kinds which form the plate stacked structure 1, and Figure 4 is a view illustrating an odd number plate 13 in which the heat radiating fin 15 is installed, Figure 6 is a view illustrating the heat radiating fin 16 in which the even number plate 14 is installed and Figure 7 is a plan view of the upper plate engaged to an upper portion of the plate stacked structure 1 and a partially cut-away cross-sectional view of the same. Figure 8 is a front and plan view illustrating the lower support which is bonded to the lowest portion of the plate stacked structure 1 and supports the plate stacked structure 1 and connects the first inlet pipe 2 to a tank with respect to each flow path formed in the interior of the plate stacked structure 1. Figure 9 is a plan view illustrating the upper support 12 which is bonded to the upper plate 17 of the plate stacked structure 1and seals the first discharging tank 1b of the upper plate 17.

As shown in Figure 3, the plate is an odd number plate 13 which is stacked in an odd number of the plate stacked structure 1. A bonding portion 130 is formed at an edge portion of the odd number plate 13. A first inlet tank portion 131 and a second discharging tank portion 132 each having a hole at a center of opposite both side corners and a bonding edge rim are protruded. Second inlet and discharging tank holes 133 and 134 each having a diameter smaller than that of the first inlet tank portion 131 are formed in both side corner portions which are opposite with respect to the first inlet and discharging tank potions 131 and 132. In addition, a plurality of mounting protrusion 135 are formed in the inner sides of the bonding portion 130.

As shown in Figure 5, the plate 14 is alternately stacked with the odd number plate 13 and is bonded to the upper and lower surfaces of the odd number plate 13. A bonding portion 140 is protruded from the edge portion of the same. The first inlet and discharging tank holes 141 and 142 and the second inlet and discharging tank portions 143 and 144 each having a hole at

the centers of the same and a bonding rim are formed in the portions corresponding to the fist inlet and discharging tank portions 131 and 132 and the second inlet and discharging tank portions 133 and 1345 of the odd number plate 13. In addition, a plurality of mounting protrusions 145 contact with each mounting protrusion 135 of the odd number plate 13 which is the stacked element at the portions corresponding to each mounting protrusion 135 of the odd number plate 13 and supports the bonding position of the even number plate 14 with respect to the odd number plate 13 and enhances a boding force with respect to the odd number plate 13.

The odd number plate 13 and the even number plate 14 receive therein a heat radiating fin 15 of Figure 4 and a heat radiating fin 16 of figure 6 each having a wrinkled structure in the interior of the bonding portions 130 and 140 between the upper support 12 and the lower support 11 and are stacked for thereby forming the above-described plate stacked structure 1 based on the blazing and bonding processes. First inlet and discharging tanks 1a and 1b are formed so that a charged air is flown into the first inlet and discharging tank portions 131 and 132 of the ode number plate 13 and the first inlet and discharging tank holes 141 and 142 of the even number plate 141 which are connected and bonded each other. The second inlet and discharging tanks 1c and 1d are formed in the second inlet discharging tank portions 143 and 144 of the even number plate 14 and the second inlet and discharging tank holes 133 and 134 of the ode number plate 13 for introducing and discharging the cooling water. The first inlet tank 1a and the first discharging tank 1b are connected with the lower surface of the odd number plate 13 through the first flow path 14a in the interior of the bonding portion 40 at a certain distance, and the second inlet tank 1c and the second discharging tank 1d are connected with the upper surface of the odd number plate 13 by the second flow path 13a. The first inlet pipe 2 is of the upper support 12 is connected with the first inlet tank 1a, and the first discharging pipe 3 of the lower support 11 is connected with the first discharging tank 1b. The second inlet pipe 4 and the second

discharging pipe 5 of the lower support 11 are connected with the second inlet tank 1c and the second discharging tank 1d. As shown in Figure 7, the upper plate 17 having the first inlet tank portion 171 and the first discharging tank portion 172 is bonded on the odd number plate 13 formed on the upper most portion of the plate stacked structure 1 and seals the second inlet and discharging tanks 1c and 1d. The upper support 12 of Figure 9 is bonded on the upper plate 17 and seals the first discharging tank 1b and supports the plate stacked structure 1 for thereby preventing a barrel shape of the plate stacked structure 1.

In the water cooling exchanger according to the present invention, the charged air inputted through the first inlet pipe 2 is flown into the first inlet tank 1a and is discharged to the first discharging pipe 3 through the first flow path 14a and the first discharging tank 1b. The cooling water inputted through the second inlet pipe 4 is flown into the second inlet tank 1c and is discharged through the second flow path 13a, the second discharging tank 1d and the second discharging pipe 5. Therefore, the charged air and cooling water are flown through the first flow path 14a and the second flow path 13a formed between the plates 13 and 14 for thereby implementing a crossing flow of the same, so that an effective heat exchange is implemented. At this time, the heat radiating fins 15 and 16 have an expanded heat transfer area with respect to the plates 13 and 14 and increase the heat exchange efficiency between two fluids.

The water cooling heat exchanger according to the present invention adapts a cooling water which as a high heat exchange efficiency as a cooling fluid, and the heat radiating fins 15 and 16 of the flow paths 13a and 14a have an expanded heat transfer areas of the cooling fluid and the cooled fluid. Therefore, a volume-to-heat exchange efficiency is high. In addition, the water cooling heat exchanger is implemented based on the plate stacked structure 1 without a housing, an assembling is significantly improved, and the fabrication cost is low.

Figure 10 is a perspective view illustrating a water cooling heat exchanger according to the present invention, and Figure 11 is a cross sectional view taken along line XII-XII of Figure 10.

In the water cooling heat exchanger according to the present invention, a lubricator which lubricates the power transfer mechanism of a vehicle is cooled, and the decrease of the density of the oil due to the temperature increase is prevented. A mechanical friction and abrasion due to the decrease of the oil density are prevented. Therefore, the water cooling heat exchanger operates as an oil cooler and has a flat ring shape. The water cooling heat exchanger is constituted to cool the engine using a cooling water.

As shown in Figures 10 and 11, the water cooling heat exchanger according to another embodiment of the present invention includes a plate stacked structure 6 which forms an oil flow path and a cooling water flow path which are alternately formed in the interior of the same, a first inlet pipe 7 and a first discharge pipe 8 for introducing and discharging the oil, and a second inlet pipe 9 and a second discharging pipe 10 for introducing and discharging the cooling water.

As shown in Figures 11 and 12, in the plate stacked structure 6, two kinds of plates 63 and 64 are alternately stacked between the upper support 62 and the lower support 61 based on the interposed heat radiating fin 66 and are bonded by the brazing method. In the interior of the same, a first flow path is formed in double lines for flowing the oil therethrough and the second flow path is formed in double liens alternately with respect to the first flow path. The oil flowing in the first flow path is heat-exchanged with the cooling water which is flown in the second flow path.

Figures 13 and 14 illustrate the odd number plate 6 which is stacked in odd number sequence and the even number plate 64 which is stacked in even number sequence for thereby forming the plate stacked structure, and Figure 15 is a plan view illustrating the heat radiating fin 66 interposed between the plates 63 and 64. Figure 16 is a view illustrating the lower plate 65 which

is first stacked in the plate stacked structure, and Figure 17 is a view illustrating the lower support 61 which is boned to the lower surface of the plate stacked structure 6 and supports the same, and Figure 18 is a plan view illustrating the upper support which is boned to the upper portion of the plate stacked structure 6, supports the upper portion of the same and connects the inlet pipes 7 and 9 and the discharging pipes 8 and 10 with respect to the tanks 6a, 6b, 6c and 6d formed in the interior of the plate stacked structure 6.

As shown in Figure 13, the plate 63 is an odd number plate 63 which is stacked in an odd number of the plate stacked structure 6. A bonding portion 630 is protruded on the edge portion of the same. A first inlet tank portion 631 and a first discharging tank portion 632 each having a hole at a center portion of the same and a bonding rim 632a are protruded on both opposite end corners. Second inlet and discharging tank holes 633 and 634 each having a hole with a diameter smaller than that of the first inlet and discharging tank portions 631 and 632 are formed at both corner portions which are crossed with respect to the first inlet and discharging tank portions 631 and 632.

As shown in Figure 14, the plate 64 is an even number plate 64 which is alternately stacked with respect to the odd number plate 63 and is bonded to the upper and lower surfaces of the odd number plate 63. The bonding potion 640 is protruded on the edge portion of the same. The first inlet and discharging tank holes 641 and 642 and the second inlet and discharging tank portions 643 and 644 are formed in the portions corresponding to the first inlet discharging tank portions 631 and 632 and the second inlet and discharging tank holes 633 and 634 of the odd number plate of the inner side. The second inlet and discharging tank portion 643 includes a hole formed at the center thereof and a bonding rim portion 643a.

As shown in Figures 11 and 12, the odd number plate 63 and the even number plate 64 each receive a heat radiating fin 66 of Figure 15 having a wrinkled structure on the interior of the bonding portion of the upper surface between the upper support 62 and the lower support 61 and are stacked and

bonded each other based on the brazing process for thereby forming the plate stacked structure 6. The first inlet and discharging tanks 6a and 6b are formed in the first inlet and discharging tank portions 631 and 632 of the odd number plate 63 and the first inlet and discharging tank holes 641 and 642 of the even number plate 64 for introducing and discharging the oil, and the second inlet and discharging tanks 6c and 6 are formed in the second inlet and discharging tank holes 633 and 634 of the odd number plate 63 and the second inlet and discharging tank portions 643 and 644 of the even number plate 64 for introducing and discharging the cooling water. The first inlet tank 6a and the first discharging tank 6b are connected through the first flow path 64a in the interior of the bonding portion 640 distanced from the lower surface of the upper side odd number plate 63, and the second inlet tank 6c and the second discharging tank 6d are connected by the second flow path 63a formed by the upper surface of the odd number plate 63. The first and second inlet pipes 7 and 9 and the first and second discharging pipes 8 and 10 bonded to the upper support 62 are connected with the first and second inlet tanks 6a and 6c and the first and second discharging tanks 6b and 6d. As shown in figure 12, the lower plate 65 of Figure 16 is stacked on the lower most portion of the plate stacked structure 6 and seals the lower portion of the second inlet and discharging tanks 6c and 6d. The lower support of figure 17 is bonded to the lower surface of the lower plate 65 and supports the upper side plate stacked structure 6 and seals the lower potion of the first inlet and discharging tanks 6a and 6d. The upper support 62 of Figure 18 is bonded to the upper most portion of the plate stacked structure 6 and supports the plate stacked structure 6 for thereby preventing a barrel structure of the plate stacked structure 6. The inlet pipes 7 and 9 and the discharging pipes 8 and 10 are connected wit the tanks 6a, 6b, 6c and 6d.

In the water cooling heat exchanger according to the present invention, the oil is introduced into the first inlet tank 6a through the fist inlet pipe 7 and is discharged to the first discharging pipe 8 through the first flow path 64a and

the first discharging tank 6b, and the cooling water is introduced into the second inlet tank 6c through the second inlet pipe 9 and is discharged to the second discharging pipe 10 through the second flow path 63a and the second discharging tank 6d. Therefore, the oil and cooling water are separately flown through the first flow path 64a and the second flow path 63a formed between the plates 63 and 64 for thereby implementing an effective hat exchange. At this time, the heat radiating fins 66 interposed in the flow paths 63a and 64a expand the heat transfer area with respect to the plates 63 and 64 for thereby enhancing a heat exchange efficiency between two fluids.

In the water cooling heat exchanger according to the present invention, since the heat radiating fins 66 installed in the flow paths 63a and 64a expand the heat transfer area of the oil which is the cooling fluid and the cooling water which the cooled fluid, the volume-to-heat exchange efficiency is high. In addition, the water cooling heat exchanger is implemented based on the plate stacked structure without a housing, the assembling process is significantly enhanced, and the fabrication cost is low.

The terms "odd number" and "even number" used throughout the description of the present invention are used for separating two kinds of plates. In the plate stacked structure, the plate stacking sequence and structure are not limited thereto.

As described above, in the water cooling heat exchanger according to the present invention, the cooling water having a high heat transfer ratio is used as a cooling fluid, and the heat radiating fins expand the heat transfer areas of the cooling water and the cooled fluid in each flow path, for thereby nehancing a heat exchange efficiency between two fluids, so that a volume-to-heat exchange efficiency is increased.

In addition, in the water cooling heat exchanger according to the present invention, the stacked and bonded plates operate as a housing and separate the flow path of the cooling fluid and the cooled fluid. Therefore, it is not needed to provide a certain element for separating the flow paths from the

housing which forms the flow paths. Therefore, it is easy to assemble the systems, and the fabrication cost is low.

As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the meets and bounds of the claims, or equivalences of such meets and bounds are therefore intended to be embraced by the appended claims.

CLAIMS

What is claimed is:

1. A water cooling heat exchanger, comprising:

a plate stacked structure in which an odd number plate and an even number plate are alternately stacked and bonded, said odd number plate having a bonding portion formed along an edge portion of the same, a first inlet tank portion and a first discharging tank portion formed in the boding portion at a certain distance from each other, and a second inlet tank hole and a second discharging tank distanced from each other and protruded; and said even number plate having a bonding portion formed along an edge portion in a certain shape capable of corresponding with the odd number plate and a first inlet and discharging tank hole corresponding to the first inlet and discharging tank portion of the odd number plate in the bonding portion and a protruded second inlet and discharging tank portion corresponding to the second inlet and discharging tank hole of the odd number plate, whereby different fluids are flown through the first inlet tank formed by the first inlet tank portion and the second inlet tank formed by the second inlet tank portions, and each fluid is flown through each flow path separated by each plate and is discharged through the first discharging tank formed by the first discharging tank portions and the second discharging tank formed by the second discharging tank portions.

2. The heat exchanger of claim 1, further comprising:

a heat radiating fin interposed between the plates for thereby expanding a heat transfer area of each fluid flowing through the flow paths between the plates.

3. The heat exchanger of claim 1, wherein said first inlet tank and second

inlet tank and said first discharging tank and second discharging tank are installed opposite to each other, respectively, so that the flowing directions of two fluids are crossed.

4. The heat exchanger of claim 1, further comprising:

upper and lower supports bonded to the upper and lower potions of the plate stacked structure for thereby enhancing a bonding strength of the stacked structure.

5. The heat exchanger of claim 4, further comprising:

a first inlet and discharging pipe bonded to opposite sides with respect to the plate stacked structure and connected with the first inlet tank and the first discharging tank; and

a second inlet and discharging pipe bonded in the same direction with respect to the plate stacked structure and connected with the second inlet tank and the second discharging tank.

6. The heat exchanger of claim 1, wherein said plates are formed of a circular flat plate, and the stacked structure is cylindrical.

Fig 1

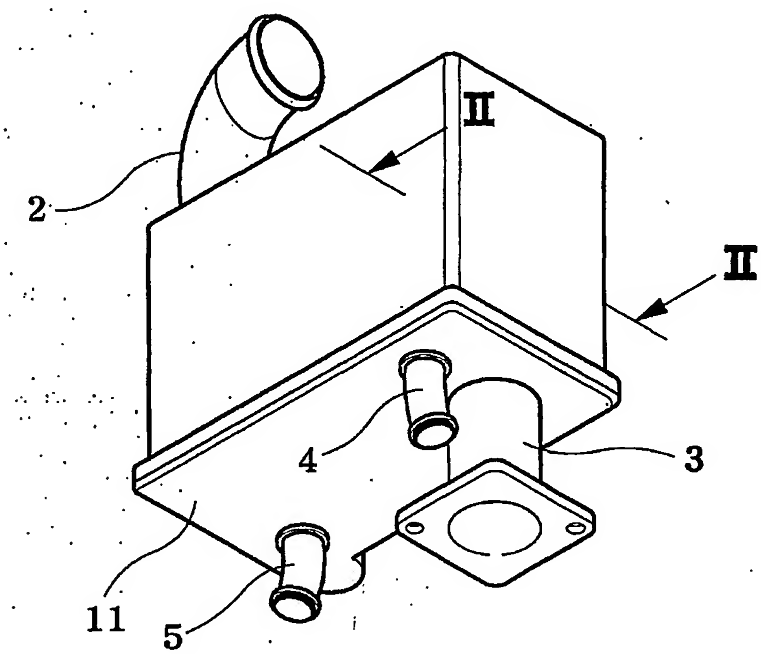

Fig 2

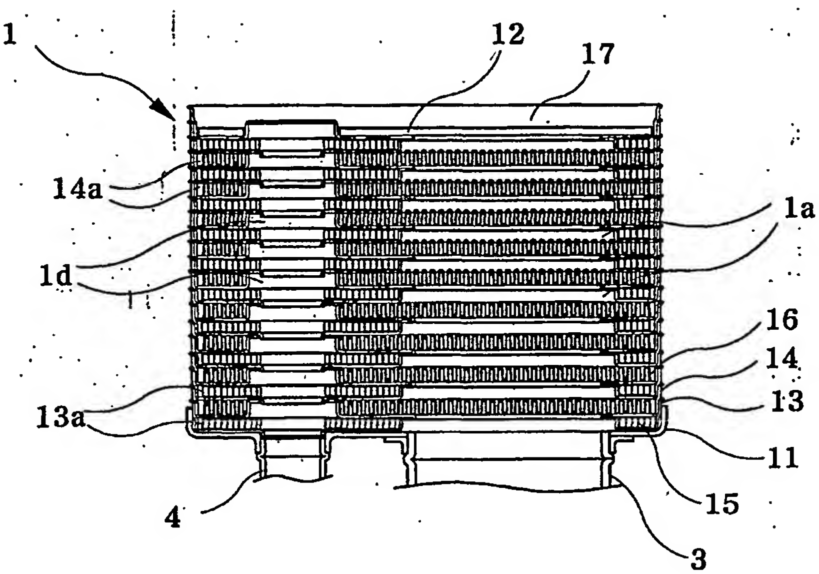
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Fig 3

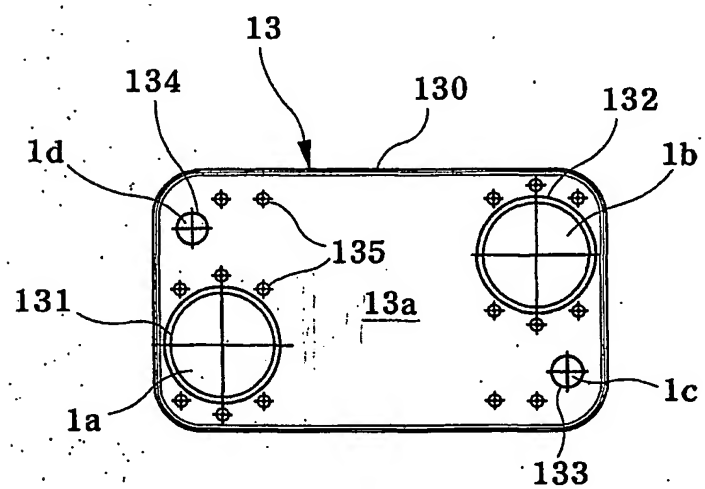
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Fig 4

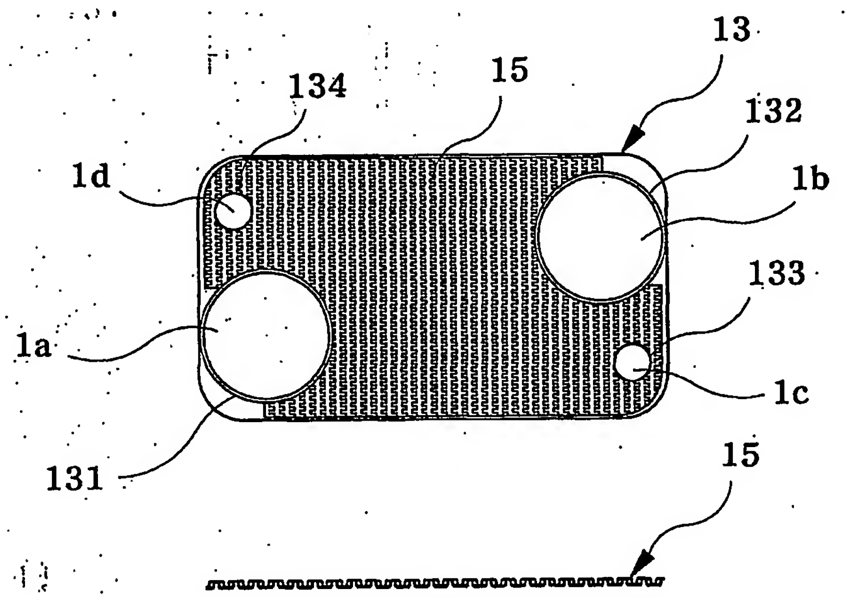
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Fig 5

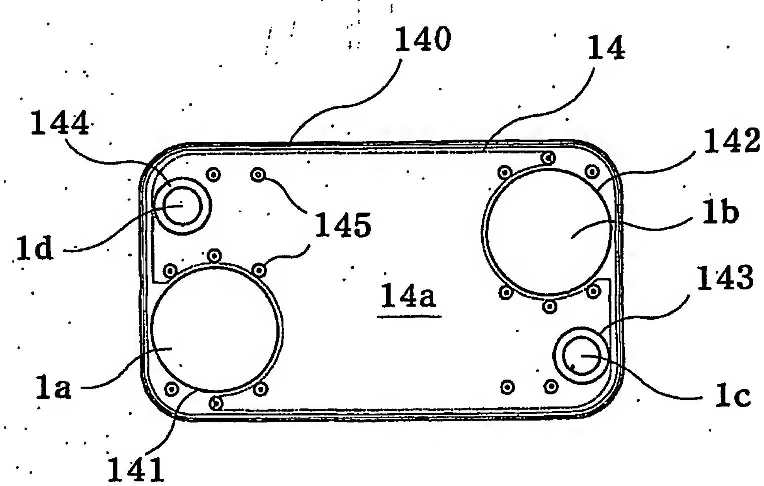
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Fig 6

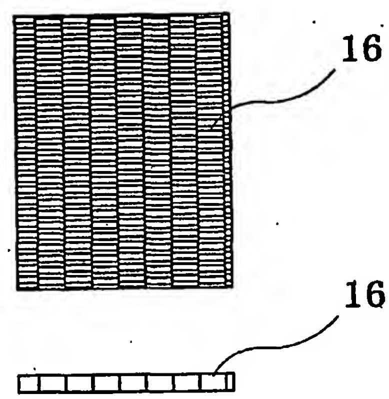


Fig 7

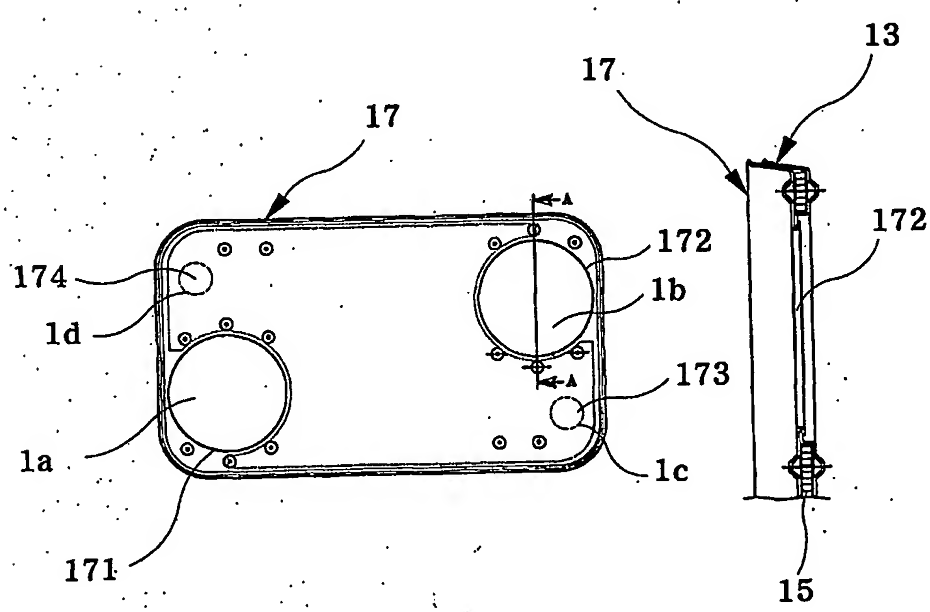


Fig 8

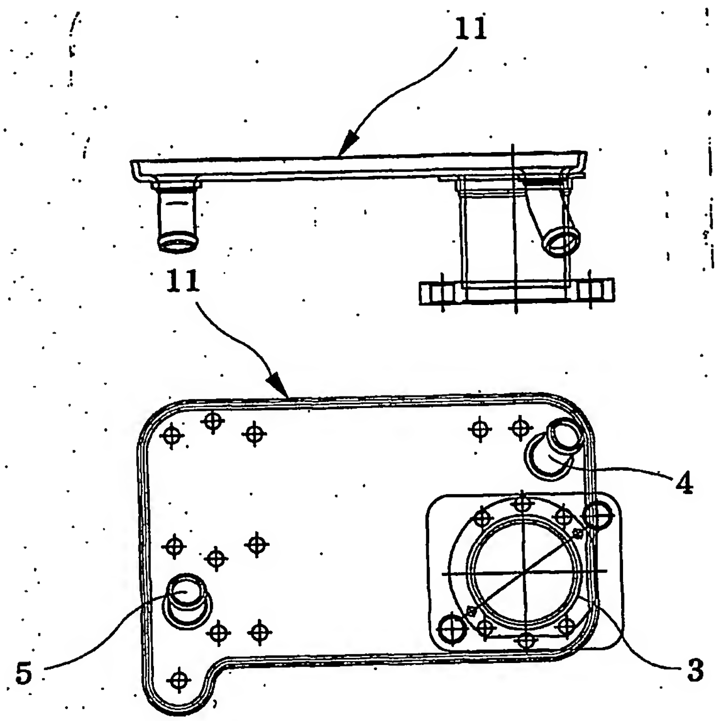


Fig 9

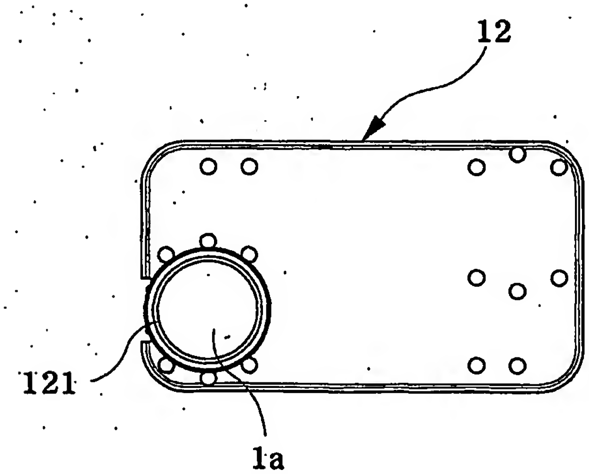


Fig 10

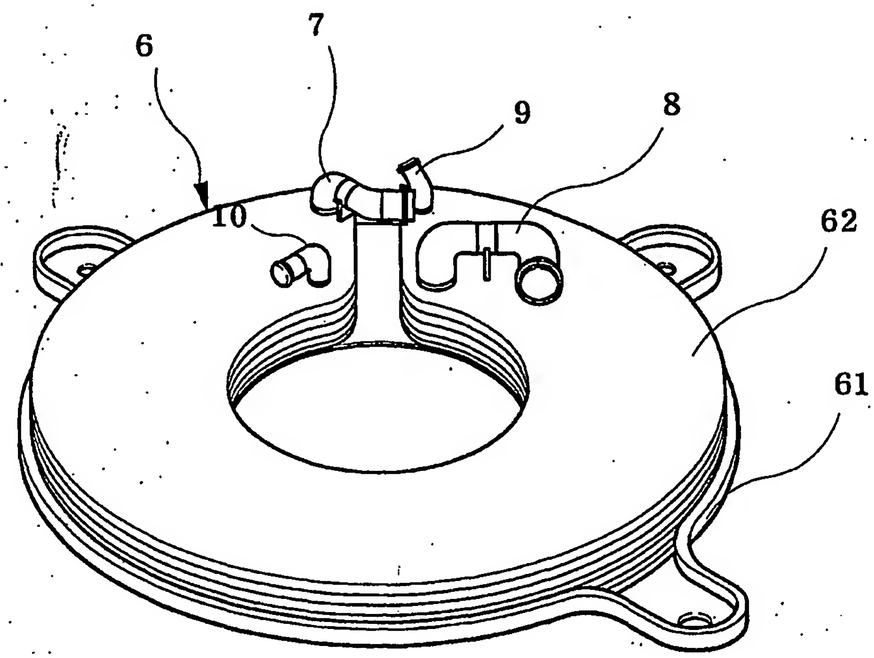


Fig 11

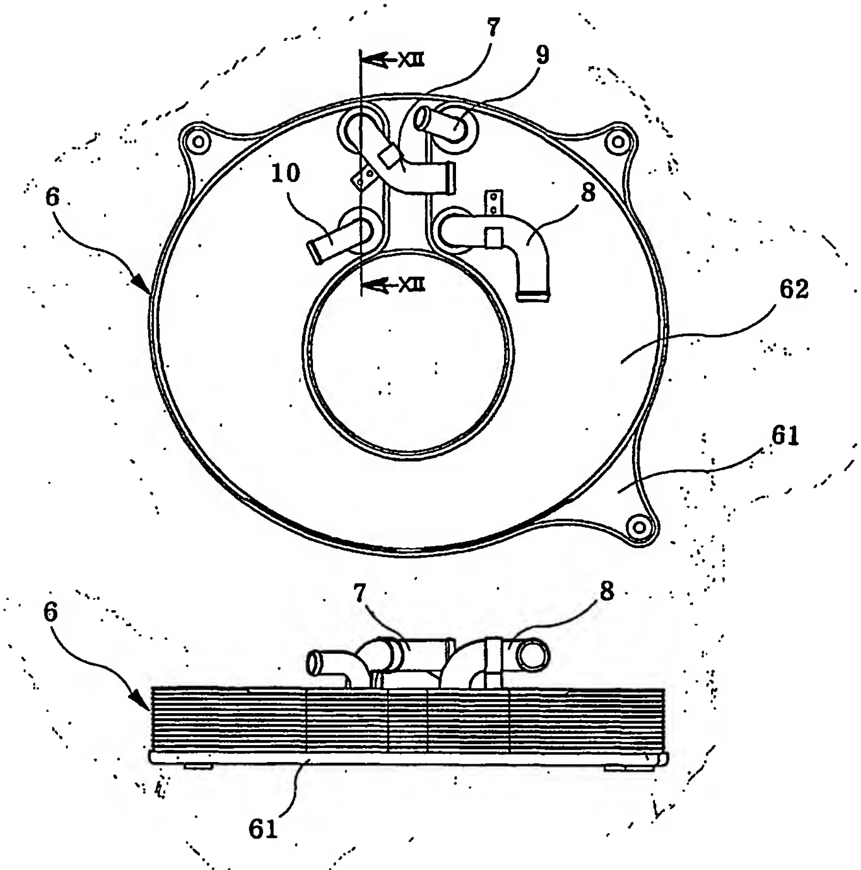


Fig 12

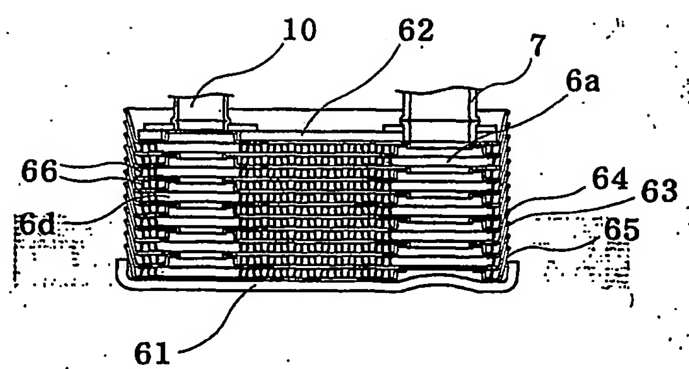
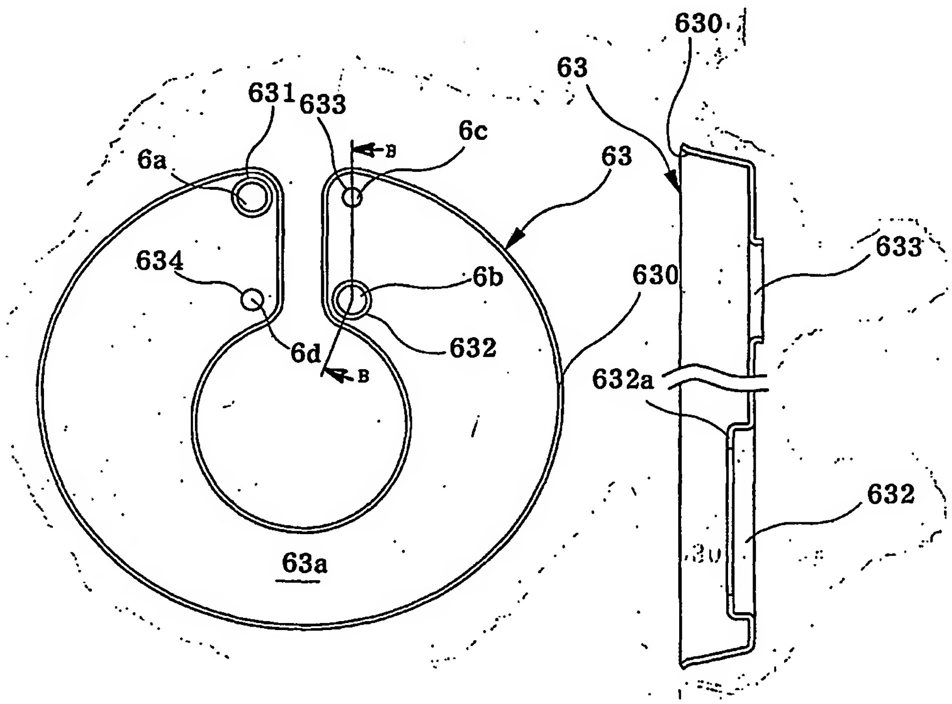


Fig 13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63a

Fig 14

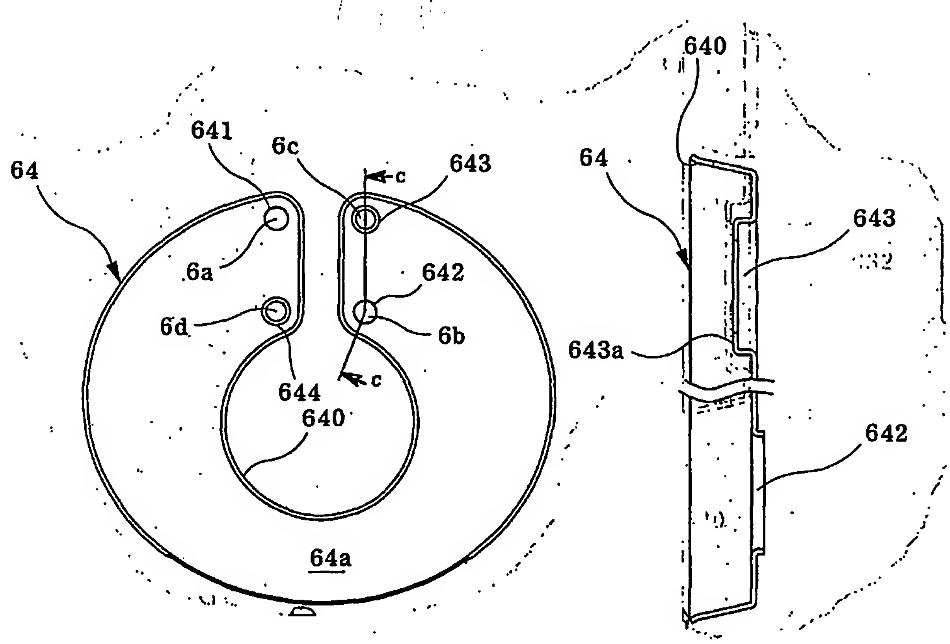
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Fig 15

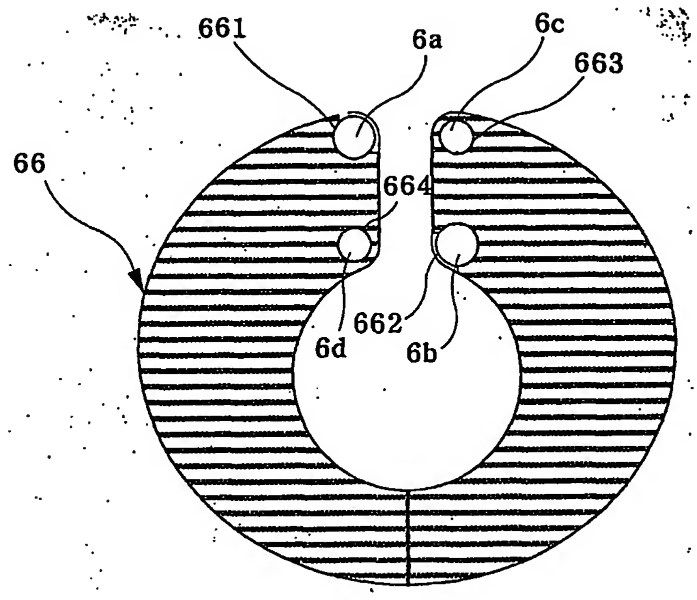


Fig 16

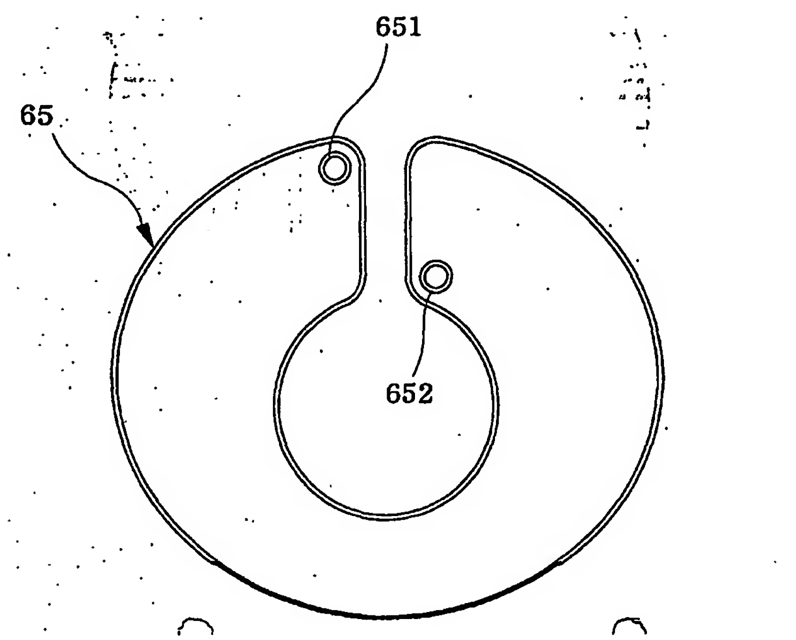


Fig 17

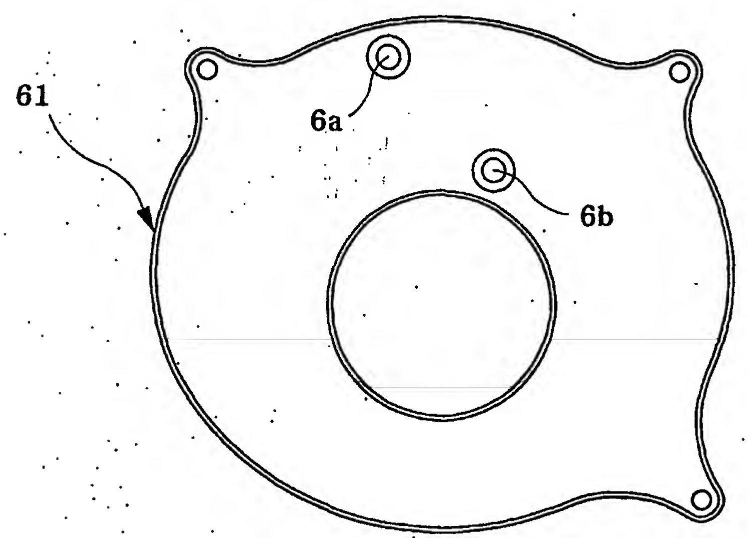
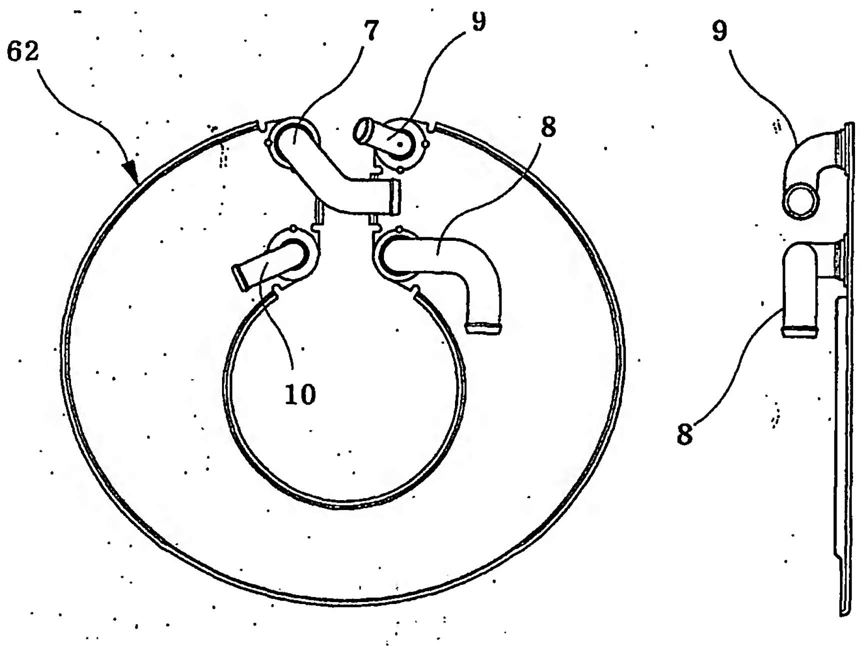


Fig 18



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR01/01951

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 F28D 3/00 9/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC7 F28D. F28F. F01M.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
KR, JP: classes as above

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 7-190650A (RINNAI CORP, OSAKA GAS CO LTD,) 28 JULY 1995 See the whole document	1,3
A	JP 7-198289A (SHOWA ALUM CORP,) 1 AUGUST 1995 See claim 1; Figure 1	1,2
A	JP 64-38471U(TOYO RADIATOR CO LTD,) 8 MARCH 1989 See the whole document	1,6

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search
26 FEBRUARY 2002 (26.02.2002)

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Name and mailing address of the ISA/KR
Korean Intellectual Property Office
Government Complex-Daejeon, 920 Dunsan-dong, Seo-gu, Daejeon Metropolitan City 302-701, Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer
KIM, Jae Wang
Telephone No. 82-42-481-5509

김재왕